Revised 5/5/2021

ROUGH-TOOTHED DOLPHIN (*Steno bredanensis*): Hawaii Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Rough-toothed dolphins are found throughout the world in tropical and warm-temperate waters (Perrin *et al*. 2009). They are present around all the main Hawaiian Islands, though are relatively uncommon near Maui and the 4-Islands region (Baird *et al*. 2013) and have been observed close to the islands and atolls at least as far northwest as Pearl and Hermes Reef (Bradford *et al*. 2017). Rough-toothed dolphins were occasionally seen offshore throughout the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands during both 2002, 2010, and 2017 surveys (Barlow 2006, Bradford *et al*. 2017, Yano *et al*. 2018; Figure 1). Rough-toothed dolphins have also been documented in American Samoan waters (Oleson 2009).

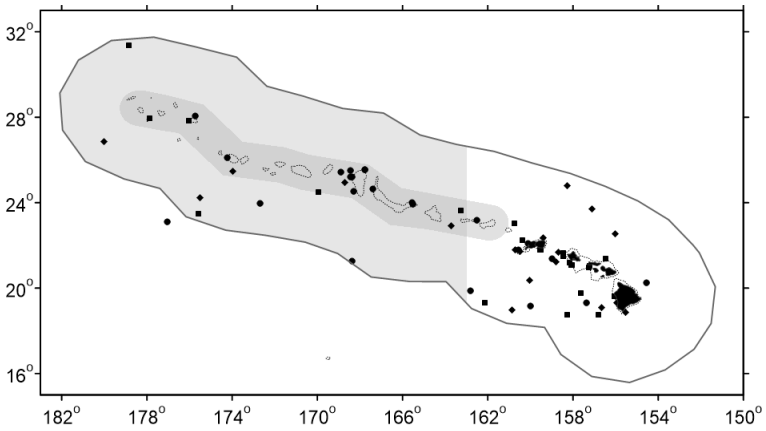

Figure 1. Rough-toothed dolphin sighting locations during the 2002 (diamond), 2010 (circles), and 2017 (squares) shipboard cetacean surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006, Bradford *et al*. 2017, Yano *et al*. 2018). Outer line represents approximate boundary of survey area and U.S. EEZ. Dark gray shading indicates of the original Papahanaumokuakea Marine National Monument, with the lighter gray shading denoting the full 2016 Expansion area. Dotted line represents the 1000 m isobath.

Population structure in rough-toothed dolphins was recently examined using genetic samples from several tropical and sub-tropical island areas in the Pacific. Albertson *et al*. (2016) found significant differentiation in mtDNA and nuDNA from samples collected at Hawaii Island versus all other Hawaiian Island areas sampled. Estimates of differentiation among Kauai, Oahu, and the northwestern Hawaiian Islands (NWHI) were lower and not statistically significant. Based on their result, Albertson *et al*. (2016) suggest that Hawaii Island warrants designation as a separate island-associated stock. Evaluation of individual rough-toothed dolphin encounters indicate differences in group sizes, habitat use, and behavior between groups seen near Hawaii Island and those seen near Kauai and Niihau (Baird *et al* 2008). Photographic identification studies suggested that dispersal rates between the islands of Kauai/Niihau and Hawaii do not exceed 2% per year (Baird *et al*. 2008). Resighting rates off the island of Hawaii are high, with 75% of well-marked individuals resighted on two or more occasions, suggesting high site fidelity and low population size. Movement data from 17 individual rough-toothed dolphins tagged near Kauai and Niihau show all individuals remained associated with Kauai with exception of one individual that moved from Kauai and Oahu and back (Baird 2016). The available genetics, movements, and social affiliation data suggest that there is at least one island-associated stock in the main Hawaiian Islands (MHI). Delineation of island-associated stocks in Hawaii is under review (Martien *et al*. 2016).

For the Marine Mammal Protection Act (MMPA) stock assessment reports, there are two Pacific management stocks: 1) The Hawaii Stock (this report), and 2) the American Samoa Stock. The Hawaiian stock includes animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of this stock is evaluated based on data from the U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

POPULATION SIZE

Encounter data from shipboard line-transect surveys of the entire Hawaiian Islands EEZ were recently reevaluated for each survey year, resulting in the following abundance estimates of rough-toothed dolphins in the Hawaii EEZ (Bradford *et al*. 2021; Table 1).

Table 1. Line-transect abundance estimates for rough-toothed dolphins derived from surveys of the entire Hawaii EEZ in 2002, 2010, and 2017 (Bradford *et al*. 2021).

Year	Abundance	CV	95% Confidence Limits
2017	76,375	0.41	35,286-165,309
2010	74,001	0.39	35,197-155,586
2002	65,959	0.39	31,344-138,803

The updated design-based abundance estimates use sighting data from throughout the central Pacific to estimate the detection function and use Beaufort sea-state-specific trackline detection probabilities for rough-toothed dolphins from Barlow *et al*. (2015). Although previous estimates from the Hawaii EEZ have been published using subsets of this data, Bradford *et al*. (2021*),* uses a consistent approach for estimating all abundance parameters and the resulting estimates are considered the best available for each survey year. Model-based density and abundance estimates were also built for rough-toothed dolphins (Becker *et al*. 2021*)*; however, only static geographic and depth variables were selected within the modeling process, precluding evaluation of inter-annual changes in density relative to other dynamic variables. The best estimate is based on the 2017 survey, or 76,375 (CV=0.41). A population estimate for this species has been made in the eastern tropical Pacific (Wade and Gerrodette 1993), but it is not known whether these animals are part of the same population that occurs around the Hawaiian Islands.

Mark-recapture estimates for the islands of Kauai/Nihau and Hawaii were derived from identification photographs obtained between 2003 and 2006, resulting in estimates of 1,665 (CV=0.33) around Kauai/Niihau and 198 (CV=0.12) around the island of Hawaii (Baird *et al*. 2008). Such estimates may be representative of smaller island-associated populations at those island areas.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow *et al*. 1995) of the 2017 abundance estimate or 54,804 rough-toothed dolphins within the Hawaiian Islands EEZ.

Current Population Trend

The three available abundance estimates for this stock have broad and overlapping confidence intervals, precluding robust evaluation of population trend for this stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaii stock of rough-toothed dolphins is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (54,804) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.5 (for a stock of unknown status with no known Hawaiian Islands EEZ fishery mortality and serious injury; Wade and Angliss 1997), resulting in a PBR of 548 rough-toothed dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality and serious injury of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Rough-toothed dolphins are known to take bait and catch from several Hawaiian sport and commercial fisheries operating near the main islands (Shallenberger 1981; Schlais 1984; Nitta and Henderson 1993). They have been specifically reported to interact with the day handline fishery for tuna (palu-ahi), the night handline fishery for tuna (ika-shibi), and the troll fishery for billfish and tuna (Schlais 1984; Nitta and Henderson 1993). Baird *et al*. (2008) reported increased vessel avoidance of boats by rough-toothed dolphins off the island of Hawaii relative to those off Kauai or Niihau and attributed this to possible shooting of dolphins that are stealing bait or catch from recreational fisherman off the island of Hawaii (Kuljis 1983). In 2014 a rough-toothed dolphin was observed off the Kona coast trailing 25-30 ft. of heavy line with two plastic jugs attached to the end of

the line (Bradford and Lyman 2018). The jugs were cut from the gear when other attempts (through pressure on the line) did not result in the removal of any other line or hooks, though all other trailing gear remained on the dolphin. This dolphin was considered seriously injured based on the amount of trailing gear. The source of the gear is not known. In 2015 a rough-toothed dolphin was observed with line tightly wrapped around and cutting into its left pectoral flipper, with 3-4 ft. of line trailing behind (Bradford and Lyman 2018). This dolphin was considered seriously injured based on information available at the time of report. This dolphin was subsequently sighted twice free of gear in 2018, indicating it survived the entanglement. As such, the serious injury determination has been revised and the dolphin is considered to be not seriously injured (Bradford and Lyman 2020). Photographs of 52 individuals with greater than 50% of the mouthline photographed showed evidence of injuries consistent with interactions with hook and line fisheries (Welch 2017). No estimates of human-caused mortality or serious injury are currently available for nearshore hook and line fisheries because these fisheries are not observed or monitored for protected species bycatch.

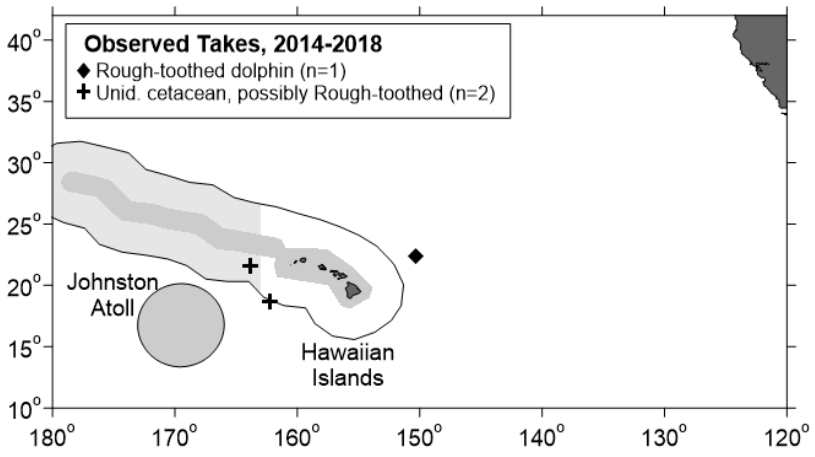

Figure 2. Locations of observed rough-toothed dolphin takes (filled diamonds) and unidentified cetacean that maybe rough-toothed dolphins based on the observer's description (crosses) in the Hawaii-based longline fishery, 2014-2018. Solid lines represent the U.S. EEZ. Gray shading notes areas closed to longline fishing, with the PMNM Expansion area closed since August 2016.

Table 2. Summary of available information on incidental mortality and serious injury of rough-toothed dolphins (McCracken 2019). Mean annual takes are based on 2014-2018 data unless indicated otherwise. Information on all observed takes (T) and combined mortality events and serious injuries (MSI) is included. Total takes were prorated to deaths, serious injuries, and non-serious injuries based on the observed proportions of each outcome.

Fishery Name	Year	Data Type	Percent Observer Coverage	Observed total interactions (T) and mortality events, and serious injuries (MSI), and total estimated mortality and serious injury (M&SI) of rough-toothed dolphins			
				Outside U.S. EEZs		Hawaiian EEZ	
				Obs. T/MSI	Estimated M&SI (CV)	Obs. T/MSI	Estimated M&SI (CV)
Hawaii-based deep-set longline fishery	2014	Observer data	21%	0	0 (-)	0	0 (-)
	2015		21%	0	0 (-)	0	0 (-)
	2016		20%	1/1	5 (0.9)	0	0 (-)
	2017		20%	0	0 (-)	0	0 (-)
	2018		18%	0	0 (-)	0	0 (-)
Mean Estimated Annual Take (CV)					1.0 (1.6)		0 (-)
Hawaii-based shallow-set longline fishery	2014	Observer data	100%	0	0	0	0
	2015		100%	0	0	0	0
	2016		100%	0	0	0	0
	2017		100%	0	0	0	0
	2018		100%	0	0	0	0
Mean Annual Takes (100% coverage)					**0**		**0**
Minimum total annual takes within U.S. EEZ							0 (-)

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Between 2014 and 2018, one rough-toothed dolphin was observed hooked or entangled in the DSLL fishery (18-21% observer coverage) (Bradford 2018a, 2018b, 2020, Bradford and Forney 2017, McCracken 2019). This interaction occurred outside the Hawaiian Islands EEZ and was observed dead (Bradford 2018a). Average 5-yr estimates of annual mortality and serious injury

for rough-toothed dolphins during 2014-2018 are zero rough-toothed dolphins within the Hawaiian Islands EEZ and 1.0 (CV = 1.6) dolphins outside of U.S. EEZs (Table 2, McCracken 2019). Two unidentified cetaceans were taken in the DSLL fishery that were considered to possibly be rough-toothed dolphins, and three additional unidentified cetaceans were taken in the DSLL that were determined only to be unidentified dolphins, some of which may have been rough-toothed dolphins.

STATUS OF STOCK

The Hawaii stock of rough-toothed dolphins is not considered strategic under the 1994 amendments to the MMPA, The status of rough-toothed dolphins in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate abundance trends. Rough-toothed dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. Two rough-toothed dolphins have been observed entangled in gear, though no dolphins have been killed or seriously injured in the deep-set longline fishery. There is no systematic monitoring for interactions with protected species within near-shore fisheries that may take this species, thus total mean annual takes are undetermined. The total number of estimated killed or seriously injured rough-toothed dolphin inside (zero) and outside (1.0) of the Hawaiian Islands EEZ is less than 10% of PBR (548), such that the fishery-related mortality or serious injuries rate for the entire Hawaii stock can be considered to be insignificant and approaching zero. Island-associated populations of rough-toothed dolphins may experience relatively greater rates of fisheries mortality and serious injury. One rough-toothed dolphin stranded in the main Hawaiian Islands tested positive for *Brucella* (Chernov 2010) and another for *Morbillivirus* (Jacob 2012). *Brucella* is a bacterial infection that if common in the population may limit recruitment by compromising male and female reproductive systems, and can also cause neurological disorders resulting in death (Van Bressem *et al*. 2009). Although *morbillivus* is known to trigger lethal disease in cetaceans (Van Bressem *et al*. 2009), its impact on the health of the stranded animal is unknown, as it was found in only a few tested tissues (Jacob *et al*. 2016). The presence of *morbillivirus* in 10 species (Jacob *et al*. 2016) and *Brucella* in 3 species (Chernov 2010) raises concerns about the history and prevalence of these diseases in Hawaii and the potential population impacts, including cumulative impacts of disease with other stressors. It is not known if *Brucella or Morbillivirus* are common in the Hawaii stock.

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